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BEHAVIORAL MOMENTUM IN THE TREATMENT OF NONCOMPLIANCE

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Behavioral momentum refers to the tendency for behavior to persist following a change in environmental conditions. The greater the rate of reinforcement, the greater the behavioral momentum. The intervention for noncompliance consisted of issuing a sequence of commands with which the subject was very likely to comply (i.e., high-probability commands) immediately prior to issuing a low-probability command. In each of five experiments, the high-probability command sequence resulted in a "momentum" of compliant responding that persisted when a low-probability request was issued. Results showed the antecedent high-probability command sequence increased compliance and decreased compliance latency and task duration. "Momentum-like" effects were shown to be distinct from experimenter attention and to depend on the contiguity between the high-probability command sequence and the low-probability command.

DESCRIPTORS: behavioral momentum, compliance latency, excessive task duration, noncompliance, high-probability command sequence

Noncompliance is one of the most commonly reported behavior problems in developmentally disabled populations (Schoen, 1983). In addition to its prevalence, treatment of noncompliance is important because of its covariation with other aberrant and adaptive behaviors. For example, several studies have demonstrated that increased compliance often results in collateral reductions in aggression, disruption, self-injury, and tantrums (e.g., Cataldo, Ward, Russo, Riordan, & Bennett, 1986; Parrish, Cataldo, Kolko, Neef, & Egel, 1986; Russo, Cataldo, & Cushing, 1981). Conversely, reduced noncompliance has been associated with increased appropriate behavior (Baer, Rowbury, & Baer, 1973). Thus, intervention to increase compliance appears to be an efficient means of improving a range of socially important behaviors.

A variation of noncompliance is slowness to respond to instructions or complete assigned tasks. Individuals who are excessively slow at completing tasks may receive less reinforcement (e.g., income from vocational tasks) and may incur punitive social responses from peers or staff.

Considerable research has evaluated procedures for increasing compliance and, to some extent, for reducing excessive compliance latency and task duration. However, much of this research has been conducted with children (Breiner & Beck, 1984; Fjellstedt & Sulzer-Azaroff, 1973; Forehand & McMahon, 1981). Procedures commonly used to increase compliance include time-out (e.g., Parrish et al., 1986) and guided compliance (e.g., Neef, Shafer, Egel, Cataldo, & Parrish, 1983). However,

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Experiment 1 and the concepts of applied behavioral momentum and the high-probability command sequence were presented at the 12th annual ABA convention (Hock & Mace, 1986). Experiments 1–5 were presented in a symposium at the 13th annual ABA convention (Mace, 1987).

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a potential liability of these procedures is that they often require physical contact with a client to achieve treatment integrity, which for large, uncooperative, or aggressive clients may be ill-advised. Alternatively, the effectiveness of differential reinforcement of compliant behavior depends on reinforcement for compliant responses being rich relative to reinforcement produced by noncompliant or dawdling behavior (cf. Ayllon, Garber, & Pisor, 1976; Cuvo, 1976; Holt, 1971). Unless a more powerful reinforcer or richer schedule can be applied to compliant behavior compared to the reinforcer and schedule maintaining noncompliance, differential reinforcement may not have the desired effect and punishment-based alternatives may need to be considered (Myerson & Hale, 1984).

Alternative approaches to increasing compliance with developmentally disabled adults may be derived from consideration of advances in basic operant research (e.g., Deitz, 1978; Hayes, Rincover, & Solnick, 1980; Michael, 1980; Pierce & Epling, 1980). For example, Nevin has discussed the relationship between response strength and rate of reinforcement (see Nevin, 1974, 1979, for reviews). Behavior maintained at steady states by interval or ratio schedules of reinforcement has been shown to persist over time following a change in reinforcement conditions (de Villiers, 1977; Nevin, 1979; Zeiler, 1977). This resistance to change in the face of altered contingencies has been referred to as "response strength" (Herrnstein, 1970; Nevin, 1979). Response strength may be relatively low when response patterns change readily or relatively high when response rates are slow to change under modified conditions. In general, behavior controlled by a multiple schedule will be more resistant to change during the schedule component that has a comparatively higher rate of reinforcement. That is, a relatively higher rate of reinforcement will result in relatively greater resistance to change or greater response strength.

Nevin, Mandell, and Atak (1983) suggested a parallel between a behavior's resistance to change and the momentum of objects in motion as described by Newton's first law of motion. They argued that it may be worthwhile to consider behavior as possessing the property of momentum. Accordingly, behavioral momentum can be analyzed in terms analogous to the product of mass and velocity in classical physics (Nevin et al., 1983, p. 49). Behavioral mass was considered formally analogous to response strength and behavioral velocity as corresponding to response rate. Nevin et al. demonstrated that behavior controlled by a two-component multiple schedule procedure was more resistant to change in the component with a relatively higher rate of reinforcement when reinforcement was provided noncontingently, or when all reinforcement was discontinued. Thus, factors that influence rate of reinforcement may be expected to affect a behavior's resistance to change.

Consideration of Nevin et al.'s (1983) work on behavioral momentum prompted us to develop a novel intervention for noncompliance and excessive compliance latency and task duration. This procedure, referred to as the high-probability command sequence, indirectly manipulates rate of reinforcement to establish what appears to be a "momentum" of compliant behavior that may persist when subjects are asked to perform a task with a low probability of compliance. Our objectives in the following series of experiments were (a) to evaluate the effectiveness of the high-probability command sequence in increasing compliance to "do" and "don't" commands (Neef et al., 1983) (Experiment 1), (b) to conduct preliminary investigations regarding the appropriateness of the behavioral momentum analogy (Experiments 2 and 3), and (c) to evaluate the generality of the procedure to reduce excessive compliance latency and task duration (Experiments 4 and 5).

EXPERIMENT 1

METHOD

Subject and Setting

Bart, a 36-year-old man with severe mental retardation (IQ = 42), served as the subject in this experiment. Bart had resided in large, state-operated institutions for most of his life and had a long history of noncompliance and aggression. Bart's large physical stature (height 6′1″, weight 200 lb) contributed to the severity of his noncompliance and aggression. In his first community placement, these behaviors eventually resulted in his recommitment to a private institution.

At the time of the present experiment, Bart had lived in a university-affiliated group home for approximately 18 months. The program was behavior-analytic in nature and was operated by university graduate students and faculty. Typical staffing patterns consisted of two graduate students working with six adults with moderate to severe mental retardation. After 6 months in this program, Bart became increasingly noncompliant and aggressive. A structured self-management program consisting of positive reinforcement for completion of house jobs and personal hygiene, without aggressive incidents, was effective only for periods of 2 to 3 months.

Sessions were conducted in the living room (5 m by 4 m), family room (3.5 m by 3 m), and kitchen (5 m by 4 m) of the home. An experimenter, one or two data collectors, and zero to two other clients were present during these sessions. Interactions between staff and other clients were minimal; client–client interactions were unrestricted. Because of the applied nature of the research, the subject was allowed free movement in these rooms to assess experimental effects under natural conditions.

Response Definitions, Measurement, and Interobserver Agreement

The principal dependent measure was the percentage of compliance to low-probability (low-*p*) "do" and "don't" commands. In Experiment 1, low-*p* commands were instructions or requests issued by the experimenter to the subject with which, in the experimenter's experience, the subject was unlikely to comply. (In the remaining four experiments, the probability value of both low-*p* and high-*p* commands was empirically determined.) Examples of low-*p* "do" and "don't" commands are "Bart, please put your lunch box away" and "Bart, please don't leave your lunch box on the table." Commands called for performance of simple tasks that could be completed within 30 to 60 s (i.e., "do" commands) or discontinuation of an undesirable behavior or condition (i.e., "don't" commands). Command compliance was defined as the subject initiating the response called for by the command within 10 s of the stated command and eventually completing the requested response(s).

The independent variable in this experiment was a sequence of high-probability (high-*p*) commands that was issued prior to a low-*p* command. High-*p* commands were instructions or requests with which the subject had a history of complying. These commands were always stated as a "do" request and are exemplified by the following: "Give me five, Bart," "Come here and give me a hug," and "Show me your pipe (or wallet, notebook, etc.), Bart." The mean percentage compliance to high-*p* commands during the entire experiment was 98%.

Two trained observers recorded (a) experimenter commands or requests directed to the subject for low-*p* and high-*p* behaviors, (b) compliance to "do" and "don't" low-*p* commands, and (c) compliance to high-*p* commands. A count of all responses was made during continuous 10-s intervals. A percentage compliance measure was derived for each session by dividing the number of compliant responses (of a given class) by the number of experimenter requests for responses (of the same class) and multiplying by 100. Observers stood within 2 to 5 m of the experimenter and subject but did not speak or make eye contact with the subject.

The second observer independently collected interobserver agreement data from a position no closer than 2.5 m from the primary observer during an average of 66% of the sessions across all phases and conditions of the experiment. For the first three experiments, total, occurrence, and nonoccurrence agreement were calculated on a point-by-point basis within all intervals per session (Page & Iwata, 1986). Table 1 presents the mean and range of interobserver agreement values for the dependent and independent variables for all experiments.

Procedures

Baseline. During each baseline session, the experimenter stood or sat within 1 to 2 m of the

Table 1
Interobserver Agreement: Mean and Range Percentages for Total Agreement (TA), Occurrence Agreement (OA), Nonoccurrence Agreement (NOA), and Agreement (A) within ±1 s across the Dependent and Independent Variables of Experiments 1 through 5

	Experiment 1			Experiment 2
	TA	OA	NOA	TA
Dependent variables				
Compliance with "do" commands	99 (93–100)	99 (93–100)	94 (63–100)	99.5 (95–100)
Compliance with "don't" commands	97 (92–100)	79 (53–100)	96 (91–100)	—
Compliance with "do" commands (during attention control)	—	—	—	99.1 (97–100)
Latency to initiate task	—	—	—	—
Minutes to complete task	—	—	—	—
Independent variables				
Compliance with high-*p* commands	93 (83–98)	85 (71–94)	89 (77–97)	94.7 (75–100)
Occurrence of high-*p*	93 (83–98)	85 (71–94)	89 (77–97)	96.4 (87–100)
Occurrence of attention	—	—	—	98.4 (97–100)
Occurrence of 5-s IPT	—	—	—	—
Occurrence of 20-s IPT	—	—	—	—
Occurrence of prompts	—	—	—	—
Occurrence of contingency statement	—	—	—	—
Delivery of reinforcement	—	—	—	—

subject. The primary data collector prompted the experimenter to issue a command to the subject on a fixed-time (FT) 1-min schedule. The experimenter made eye contact with the subject and issued a low-*p* command or request to Bart in a pleasant tone of voice. Low-*p* commands were selected at random from a pool of 20 low-*p* commands or, in the case of many low-*p* "don't" commands, were chosen on the basis of the subject's behavior (e.g., "Bart, don't put your feet on the coffee table"). If the subject satisfied the definition of command compliance, the experimenter provided immediate descriptive praise (e.g., "That's good Bart, thanks for putting your lunch box away"). Descriptive praise was used as a consequence for compliance for subjects in all five experiments because, in the experimenters' experience, praise appeared to be an effective reinforcer for these individuals. "Do" and "don't" command sessions differed only in the class of commands issued to the subject (i.e., either all "do" or all "don't" low-*p* commands).

Psychotropic intervention—Haldol. On Day 7 of the experiment, Bart's psychiatrist prescribed 10 mg of Haldol b.i.d. to control his aggressive behavior. This represented a return-to-Haldol intervention, which Bart had experienced during the past 7 years, after a 6-week period of medication withdrawal. Baseline procedures remained in effect. Psychotropic intervention continued during all subsequent phases of the experiment.

High-probability command sequence. This condition was identical to the baseline procedures except that each low-*p* command was preceded by a sequence of high-probability (high-*p*) commands. The high-*p* command sequence consisted of the experimenter issuing a series of three or four high-*p* commands or requests to the subject immediately preceding presentation of the low-*p* command.

Table 1
(*Continued*)

Experiment 2		Experiment 3			Experiment 4		Experiment 5	
OA	NOA	TA	OA	NOA	TA	A ± 1 s	TA	A ± 1 s
96.7 (69–100)	99.6 (96–100)	99 (92–100)	98.7 (92–100)	97 (80–100)	—	—	—	—
—	—	99 (93–100)	97 (88–100)	97 (82–100)	—	—	—	—
90.9 (71–100)	99.4 (97–100)	—	—	—	100	—	—	—
—	—	—	—	—	—	100	—	—
—	—	—	—	—	—	—	—	100
95 (77–100)	97.1 (86–100)	95 (90–100)	95 (88–100)	93 (79–100)	100	—	100	—
95.4 (82–100)	97.1 (92–100)	96 (91–100)	96 (92–100)	94 (87–100)	100	—	100	—
94 (88–100)	98.6 (95–100)	—	—	—	100	—	—	—
—	—	99 (98–100)	96 (88–100)	99 (96–100)	—	—	—	—
—	—	99 (98–100)	95 (82–100)	99 (97–100)	—	—	—	—
—	—	—	—	—	—	—	100	—
—	—	—	—	—	—	—	100	—
—	—	—	—	—	—	—	100	—

High-*p* commands were issued at 10-s intervals (i.e., the interval between completion of a high-*p* task and the next high-*p* command).

Experimental Design

The experimental conditions described above were presented to the subject during two 15-min sessions daily that were separated by a 15- to 30-min free time period. Because "do" and "don't" commands have been shown to be members of different stimulus classes (Neef et al., 1983), sessions with either all "do" commands or all "don't" commands were alternated in a multielement design (Sidman, 1960). The order in which "do" and "don't" command sessions were conducted was determined randomly each day. In addition, the independent variable was alternately applied and withdrawn during "do" and "don't" command sessions in the context of a reversal design (Sidman, 1960).

Results

Figure one represents Bart's percentage of compliance to low-*p* commands during "do" and "don't" command sessions across all phases of the experiment. During baseline, Bart's compliance to low-*p* requests during "do" sessions averaged 47% and during "don't" sessions 53.5%. With the addition of psychotropic medication, mean compliance to "do" commands was 68% versus 53.5% for "don't" commands.

During Phase 3, application of the high-*p* command sequence prior to each "don't" command resulted in an increase in mean compliance to 87.5%. Compliance to "do" commands, which remained under baseline conditions, averaged only 61%. In Phase 4, the pattern of compliance reversed with "do" command sessions increasing to a mean of 90.5% following application of the high-*p* com-

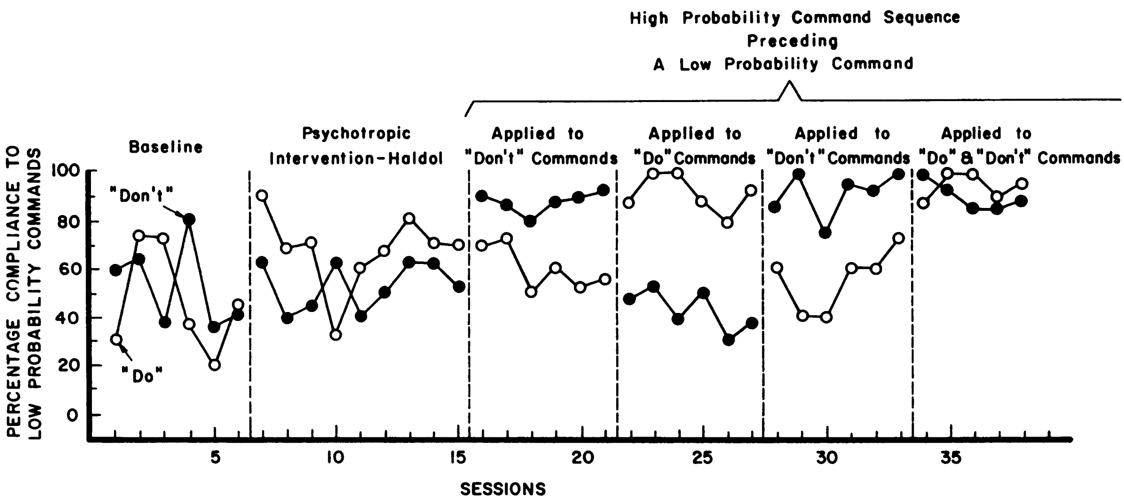

Figure 1. Bart's percentage compliance to low-probability "do" and "don't" commands under baseline and psychotropic intervention conditions, and alternate application and withdrawal of the high-probability command sequence.

mand sequence. "Don't" command compliance returned to low levels during this period (M = 44%). In the fifth phase, compliance to "don't" commands returned to high levels when low-p commands were preceded by a series of compliant responses (M = 91%). Compliance to "do" commands, which were not preceded by the high-p command sequence, averaged only 56%. In the final experimental phase, use of the high-p command sequence resulted in high levels of compliance to both "do" and "don't" commands. Mean compliance ranged from 87% to 97% for "do" command sessions (M = 93%) and 85% to 97% for "don't" command sessions (M = 90%).

Discussion

This experiment demonstrated the effectiveness of preceding a low-probability command with a sequence of high-probability commands in the treatment of noncompliance. Establishing a pattern of compliant responding by the subject immediately prior to the issuance of a low-p request resulted in increases in the subject's compliance. Our objective in the second experiment was to assess the subject generality of the high-p procedure and to examine possible effects of positive attention alone on compliance.

EXPERIMENT 2

Method

Subject and Setting

The subject of the second experiment was Ned, a 44-year-old severely retarded (IQ = 21) male with Down Syndrome. Ned had lived in institutions for most of his life. When asked to perform a task, Ned typically shook his head "no" and looked away. Occasionally, he would throw items, curse, spit, hit others, or lie on the floor when such commands were issued.

The setting for the study was the same house as in Experiment 1. During the first four phases of the experiment, baseline and treatment high-p command sessions were conducted in the kitchen. Attention control sessions were held in the subject's second floor bedroom (4 m by 3.5 m). Persons present and their interactions during the sessions were similar to those in the first study.

Response Definitions, Measurement, and Interobserver Agreement

Ned primarily did not comply with "do" requests. The procedure for identifying commands to which the subject had a low probability of complying consisted of the experimenter approaching

Ned and asking him to perform each of 25 tasks on separate occasions. Ten separate trials were conducted for each of the 25 tasks; those commands that were complied with four or fewer times in 10 trials were designated as low-*p* commands. This procedure resulted in a pool of 15 low-*p* "do" commands that were used in the experiment. A similar procedure used with high-probability commands (i.e., at least 80% compliance) resulted in the following high-*p* command sequence: (a) "Ned, give me five," (b) "Give me a bump" (i.e., the experimenter and subject bumped hips in a dancing motion), and (c) "Ned, show me your radio."

The definition of command compliance and the data collection procedures for the primary and secondary observers were identical to those in Experiment 1 (see Table 1 for interobserver agreement values).

Procedures

Baseline. The actions of the experimenter and data collectors during this condition were virtually identical to those described for the baseline condition for Experiment 1.

High-probability command sequence. The presentation of the high-*p* command sequence and the experimenter's response to compliance were identical to the procedures used during this condition in the first experiment.

Attention control. This condition was designed to provide experimenter attention prior to issuance of a low-*p* command without providing specific discriminative stimuli for behaviors presumably maintained by high rates of reinforcement. On an FT 1-min schedule, the experimenter sat or stood within 1 to 2 m of the subject and directed a sequence of three or four neutral or positive comments to the subject. Comments were randomly selected from a pool of 25 statements. The interval between comments ranged from 10 to 15 s. Examples of these comments included "Ned, that's a nice shirt you're wearing," "We're going bowling this afternoon," and "I'm going to visit my parents this weekend." Within 10 s of the last comment, the experimenter issued a randomly selected low-*p* command to the subject. Compliance to low-*p* commands resulted in descriptive praise on a continuous reinforcement (CRF) schedule.

Experimental Design

The experimental procedures were presented daily during two 15-min sessions separated by a 15- to 30-min free time period. An ongoing attention control condition was alternated with either the baseline or the high-*p* command sequence condition in a multielement design. The order in which conditions were conducted was determined randomly each day. The effects of the high-*p* command sequence were evaluated with an A-B-A-B reversal design. In the final phase of the experiment, the settings in which the high-*p* command sequence condition and the attention control condition were conducted were reversed to control for possible effects of setting-specific commands.

RESULTS

Figure 2 depicts Ned's compliance to low-*p* commands during all baseline, high-*p* command sequence, and attention control conditions. In the initial baseline phase, issuing low-*p* commands without a preceding high-*p* command sequence resulted in a mean compliance of 26%. When experimenter attention preceded each low-*p* command, compliant behavior was similar to baseline (M = 35%). During Phase 2, application of the high-*p* command sequence effected an increase in mean compliant responses to 73%. Compliance during the attention control sessions remained essentially unchanged from the previous phase (M = 38%).

A return to baseline condition in the third phase produced an immediate decrease in the subject's percentage compliance (M = 39%). Comparable levels of compliance (M = 43%) continued during the subsequent attention control condition. In the fourth phase, high levels of compliance occurred when the high-*p* command sequence was reinstated (M = 84%). Average percentage compliance increased slightly during the ongoing attention control condition (M = 51%). Finally, the setting reversal had little effect on the subject's pattern of compliance during the high-*p* command sequence (M = 79%) and attention control conditions (M = 47%).

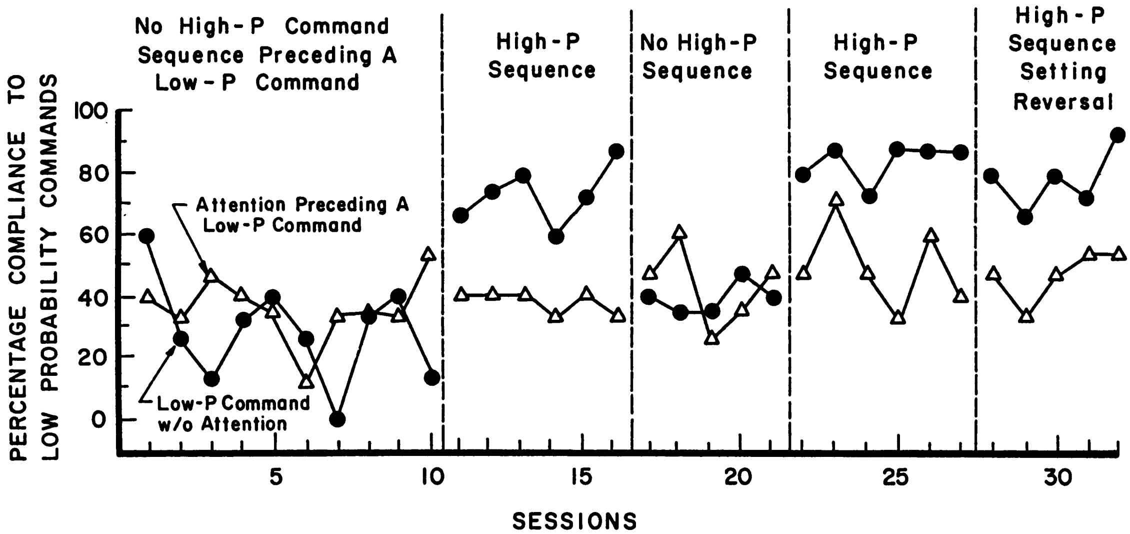

Figure 2. Ned's percentage compliance to low-probability commands during the attention control condition and alternate application and withdrawal of the high-probability command sequence. In the final experimental phase, the settings in which the attention control and high-*p* sequence were conducted were reversed.

Discussion

Results of the second experiment support the subject generality of the effects produced by the high-*p* command sequence inasmuch as the effects for Ned and Bart were similar. A second important finding was that experimenter attention was not itself sufficient to occasion compliance to low-*p* requests. That is, experimenter comments presented in the same manner as high-*p* commands failed to influence the probability of subject compliance. This finding suggests that presentation of discriminative stimuli for high-probability behaviors is critical to the momentum-like effects observed.

In the third experiment, we investigated another parameter of the high-*p* command procedure that may determine its effectiveness as an applied procedure and further examines the value of the behavioral momentum analogy. Nevin et al. (1983) found that resistance to change or behavioral momentum was directly related to rate of reinforcement. The higher the relative rate of reinforcement, the greater the resistance to change. Therefore, it may be logical to predict that momentum-like effects will decrease with an increase in the interval between the last high-*p* command in the sequence (or between any high-*p* commands in the sequence) and the statement of the low-*p* command. Increasing this interval presumably has the effect of decreasing rate of reinforcement which, in turn, should decrease behavioral momentum.

EXPERIMENT 3

Method

Subject and Setting

The subject and setting in which experimental sessions were conducted were identical to those described in Experiment 1. Bart continued to take 10 mg of Haldol b.i.d. for the duration of the study. This experiment was conducted 1 month after completion of the first study.

Response Definitions, Measurement, and Interobserver Agreement

As in Experiment 1, the principal dependent measure in the third experiment was the percentage compliance to low-*p* "do" and "don't" commands. The procedure described in Experiment 2 to identify low- and high-probability commands was used to define a pool of 15 low-*p* "do" commands, 10 low-*p* "don't" commands, and seven high-*p* "do"

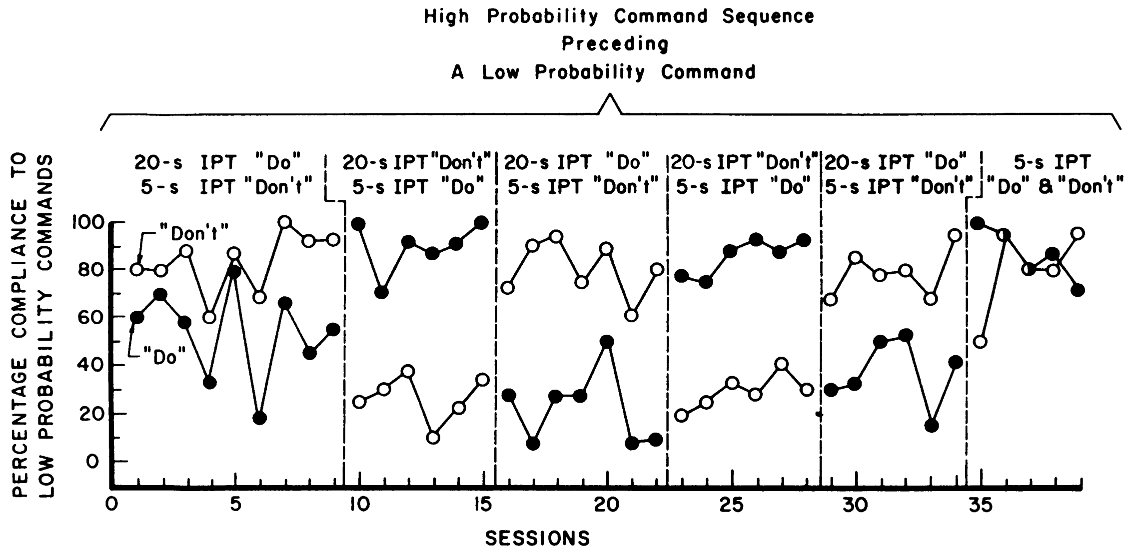

Figure 3. Bart's percentage compliance to low-probability "do" and "don't" commands during 5-s and 20-s IPT applications of the high-probability command sequence.

commands. Additional low-*p* "don't" commands were extemporaneously selected during "don't" command sessions corresponding to the subject's aberrant behavior.

Definitions and procedures used to measure command compliance for "do" and "don't" low-*p* commands and high-*p* commands were identical to Experiment 1. The independent variable manipulated in this study was ***interprompt time*** (IPT). IPT was defined as the time interval beginning with the cessation of the last high-*p* command in the high-*p* command sequence and ending with the onset of the low-*p* command. Independent observers measured this interval using a stopwatch. Time measurements within ± 2 s were considered in agreement. Interobserver agreement measures were taken for the dependent and independent variables on an average of 53% of the sessions during all phases and conditions of the study (see Table 1).

Procedures

High-probability command sequence—20-s IPT. All procedures in this condition were identical to those described for the high-*p* command sequence in Experiment 1 with one exception. After the last high-*p* command in the high-*p* command sequence was issued, the experimenter paused 20 s without speaking to the subject, and then stated a randomly selected low-*p* "do" command or a low-*p* "don't" command that corresponded to the subject's inappropriate behavior. The primary data collector timed the IPT interval and nonvocally cued the experimenter to deliver the low-*p* command.

High-probability command sequence—5-s IPT. This condition consisted of the same procedures described for the high-*p* command sequence in the first study except that the 5-s IPT interval was timed by the primary data collector.

Experimental Design

The high-*p* command sequence preceded each low-*p* command in all sessions of the experiment. "Do" command sessions and "don't" command sessions were alternated in a random order daily according to a multielement design. The effects of 5-s and 20-s IPTs were compared by alternately applying each IPT condition to "do" and "don't" command sessions across successive phases of the study in the context of a reversal design.

Results

Bart's compliance to low-*p* "do" and "don't" commands under 5-s and 20-s IPT conditions is presented in Figure 3. During Phase 1, application of the high-*p* command sequence with a 5-s IPT to "don't" commands resulted in consistently higher compliance (M = 83%) than the high-p sequence with a 20-s IPT applied to "do" commands (M = 53%). When IPT conditions were reversed in the second phase, mean compliance to "do" commands using a 5-s IPT increased to 89%, whereas compliance to "don't" requests dropped with the use of a 20-s IPT to an average of 27%. The reversal pattern continued during Phases 3 through 5. Mean percentage compliance with the 5-s IPT was 80%, 86%, and 78% for Phases 3, 4, and 5, respectively. By contrast, the high-p command sequence with a 20-s IPT resulted in low levels of compliance. Percentage compliance averaged 22%, 29%, and 37% during the third through fifth phases of the experiment, respectively. In the final phase, compliance averaged 91% for "do" commands and 78% for "don't" commands when the high-p procedure was used with the 5-s IPT for both stimulus classes.

Discussion

Two important findings may be gleaned from the third experiment. First, the momentum-like effects produced by the high-p command sequence appear to depend on the temporal contiguity between the high-p command sequence and the low-p command. The relatively longer IPT interval failed to elevate compliance levels above those achieved by this subject during the baseline phase of Experiment 1. Thus, on the basis of this subject's data, it appears that practitioners must ensure that low-p commands are issued immediately after the high-p sequence. Extensions of the IPT interval appear to negate the controlling effect that high-p commands have on compliant behavior. Second, these findings may have been due to differences in the rate of reinforcement between the 5-s and 20-s IPT condition. Issuing three high-p commands at 10-s intervals followed by a low-p command at an IPT of 20 s results in a reinforcement rate that is approximately half the rate using a 5-s IPT. Thus, the results of Experiment 3 are predicted by the behavioral momentum analogy, if rate of reinforcement is analogous to behavioral mass as Nevin et al. (1983) have argued.

The fourth and fifth experiments examined the application of the high-p command procedure to a problem related to noncompliance, excessive response latencies. These studies investigated whether the high-p command procedure could reduce subjects' latency to respond to experimenter commands or requests to perform tasks.

EXPERIMENT 4

Method

Subjects and Setting

Two adult men with moderate mental retardation served as subjects. Tim was a 34-year-old male with Down Syndrome (IQ = 53) who lived with his parents until age 33. He performed most self-care skills and household tasks independently. However, the speed with which he responded to staff requests was extremely slow. During the period following staff instructions, Tim would typically engage in various forms of stereotypy or stare into space and move very slowly toward initiation of the task.

The second subject, Mitch, was 45 years old (IQ = 47) and had lived most of his life in state-operated institutions. He had grand mal seizures that were controlled by 500 mg of Tegretol and 250 mg of Mysoline per day. His psychiatrist also prescribed 100 mg of Mellaril per day to control his "psychotic" behavior, which consisted of talking to himself or talking out of context. Mitch was skilled at most self-care and household tasks; however, he was sometimes very slow to respond to staff requests or spent excessive periods of time performing tasks such as showering, making his bed, or preparing his lunch. When off-task, Mitch would typically stare into space or talk to himself.

Both subjects lived in the community group home described in Experiment 1. All sessions were conducted in the kitchen.

Response Definitions, Measurement, and Interobserver Agreement

The dependent measure for both subjects was compliance latency defined as the interval beginning with the completion of an experimenter's instruction and ending with initiation of the specified task. Task initiation for Tim was defined as lifting his plate or glass from the dining table. For Mitch, task initiation entailed performing one of the following depending on the task selected: (a) lifting the kitchen trash container, (b) lifting a broom, or (c) touching the mirror-cleaning materials. Compliance latency was measured in seconds by the experimenter using a stopwatch. A trained independent observer collected interobserver agreement measures for the dependent and independent variables on an average of 52% and 40% of the sessions across conditions of the study for Tim and Mitch, respectively. All interobserver latency measures agreed to within ± 1 s (see Table 1).

Measures of the integrity of the independent variables were obtained for all sessions. Event records were collected for the following variables during their respective experimental sessions: (a) occurrence of high-*p* commands, (b) compliance with high-*p* commands, and (c) occurrence of attention statements. The integrity measures indicated that the experimenter issued high-*p* or attention statements according to the procedures on 100% of the compliance trials. Compliance to high-*p* commands was 100% for both subjects. Interobserver agreement calculated on a trial-by-trial basis was 100% for all independent variables (see Table 1) (Page & Iwata, 1986).

Procedures

Baseline: No high-probability command sequence. For Tim this condition was conducted immediately after he finished eating his breakfast, lunch, or dinner. Tim was seated along one side of an oblong dining table and the experimenter was seated across from him. Within 5 s of the subject placing his napkin on his plate indicating the end of the meal, the experimenter made eye contact with Tim and issued the following instruction: "Tim, please clear your place at the table." The experimenter remained seated and directed no other comments to Tim until he complied with the task request (i.e., rinsed his plate and glass and placed them in the dishwasher). Descriptive praise was provided immediately after Tim performed the task.

During baseline for Mitch, the experimenter took Mitch into the kitchen where all task materials were located and issued one of the following five randomly selected task commands: (a) "Mitch, please empty the trash," (b) ". . . sweep the downstairs (or upstairs) bathroom floor," or (c) ". . . clean the downstairs (or upstairs) bathroom mirror." Procedures for descriptive praise were identical to those described for Tim.

High-probability command sequence. Procedures in this condition were identical to baseline, except preceding the statement of each task request, the experimenter delivered the following sequence of high-*p* commands in a manner identical to that described in Experiments 1 through 3: "Tim (or Mitch), shake my hand," "Tim (or Mitch), give me five," and "Tim (or Mitch), give me a hug." Within 10 s of the subject's compliance to the last high-*p* command in the sequence, the experimenter issued the task request described for each subject during baseline.

The probability value of each high-*p* command was determined empirically prior to the experiment. Ten separate trials for each of the high-*p* requests were conducted for both subjects. Trials were separated by at least 15 min. Both subjects complied with all high-*p* requests 100% of the time during this preliminary assessment.

Attention control. Procedures in this condition were the same as those described in Experiment 2.

Experimental Design

Experimental conditions were presented in the context of a multielement design. During the first 9 days of Tim's study, the baseline, high-*p* command sequence, and attention control conditions were administered one per day in a random order across days without balancing the number of times each condition was conducted. On Days 10 through 27 these conditions were administered in a random and balanced order.

Six sessions were conducted for Mitch each day, with two of each of the three types of tasks represented (i.e., empty trash, sweep floor, clean mirror). Each day of the experiment a baseline and high-*p* command sequence condition were con-

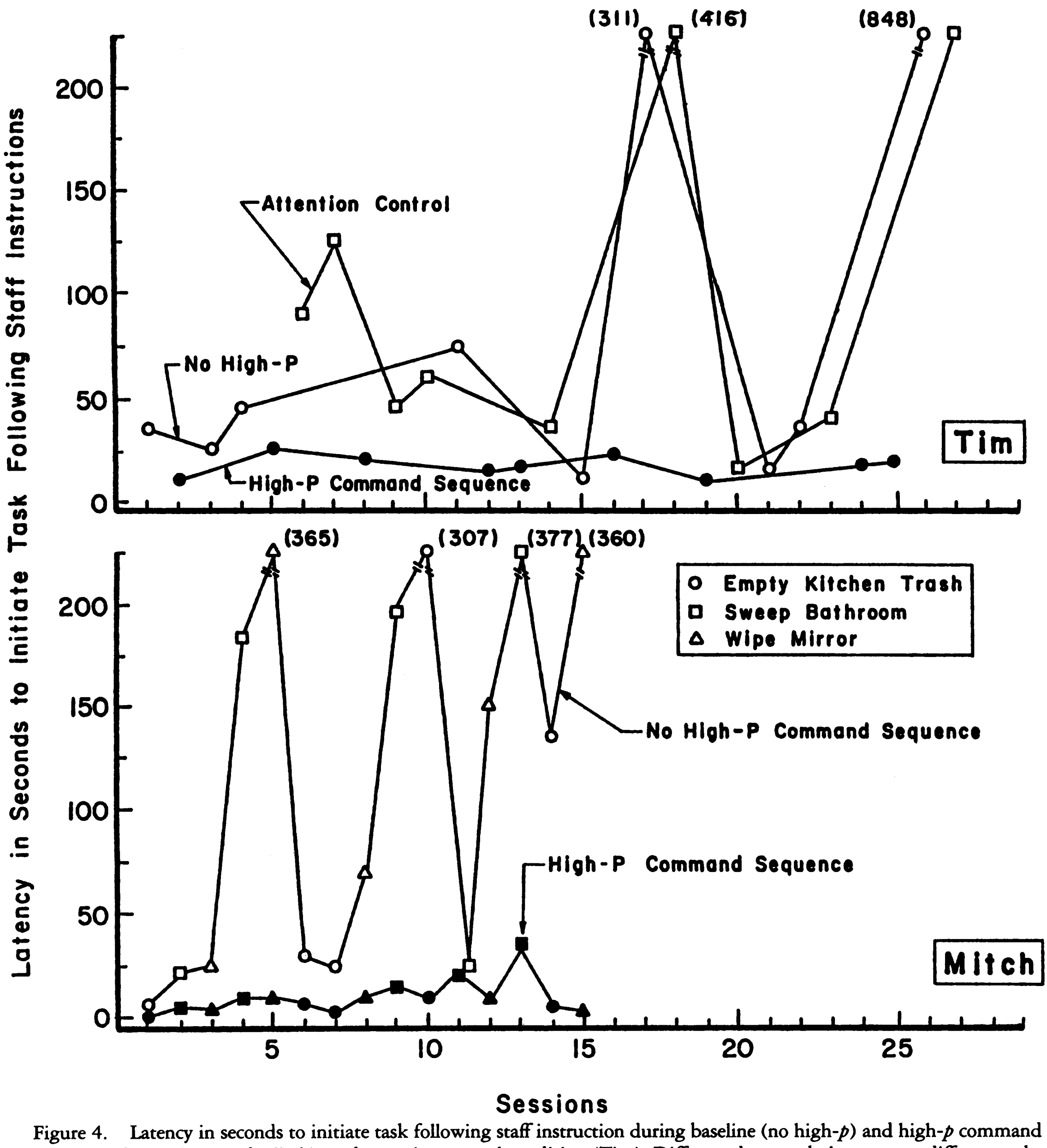

Figure 4. Latency in seconds to initiate task following staff instruction during baseline (no high-*p*) and high-*p* command sequence condition (Tim and Mitch), and attention control condition (Tim). Different data symbols represent different tasks for Mitch.

ducted for each of the three task pairs. The order in which these six sessions were conducted was determined randomly on a daily basis.

Results

Figure 4 represents the subjects' latency to initiate each task following a staff instruction during the different experimental conditions. During the baseline or no high-*p* command sequence condition, Tim's compliance latency varied greatly from 12 s to 848 s (M = 156 s). Experimenter comments prior to the task command during the attention control condition produced results similar to baseline. Mean compliance latency was 117 s with a range of 16 s to 416 s. By contrast, Tim consistently responded quickly to experimenter instructions that were preceded by the high-*p* command sequence. His average latency to compliance was 17 s, with a narrow range of 11 to 25 s.

Similar results were obtained for Mitch. Without the preceding high-*p* command sequence, compliance latency was quite variable and often lengthy. During baseline, the average latency to compliance across all three task types was 151 s (range, 5 s to 377 s). Use of the high-*p* command sequence sharply reduced the subject's latency to comply. Mean compliance latency with the high-*p* procedure was 10 s across all task types. Momentum-like effects were also usually consistent across the three types of tasks used in the experiment. With the high-*p* command sequence, average latencies to initiate emptying trash, sweeping floors, and cleaning mirrors were 5 s, 17 s, and 8 s, respectively. Without the high-*p* procedure, compliance latencies averaged 98 s, 160 s, and 194 s for the three tasks, respectively.

The fifth experiment extended the application of the high-*p* command sequence to reduce the time a subject spent performing an entire task. When applied to reduce task duration, the high-*p* command procedure was presented when off-task behavior or dawdling occurred in the course of performing the task. Because the high-*p* command sequence requires continual supervision of the task and is more complex to administer than simple prompts to resume task-related behavior, the applied value of the high-*p* procedure for reducing excessive task duration depends on it being highly effective. For this reason, the fifth study compared the effectiveness of the high-*p* command sequence with simple prompts and a contingency management procedure.

EXPERIMENT 5

METHOD

Subject and Setting

Mitch (of Experiment 4) served as the subject in this study. The target behavior of interest was the excessive amount of time Mitch spent taking a shower.

The study was conducted in the group home's second floor bathroom (2.5 m by 3.5 m) and Mitch's bedroom (5 m by 5 m). The bathroom was equipped with a tub, shower head, and plastic shower curtain, and was located 6 m down the hallway from Mitch's bedroom. In general, only the experimenter and secondary observer were present during experimental sessions.

Response Definitions, Measurement, and Interobserver Agreement

Showering sessions were divided into three task segments which Mitch, on average, spent comparable amounts of time performing. The dependent measure was the time elapsed to complete each of the three task segments. Task Segment 1 was shower preparation and was defined as the period beginning with the experimenter's instruction "Mitch, it's time to take your shower" and ending with the subject entering the bathroom wearing his bathrobe and slippers and carrying a towel and washcloth. During this segment the subject undressed in his room, put his clothes away, dressed in his bathrobe and slippers, and obtained a towel and washcloth from his drawer. The second task segment was showering, which began with the end of Task Segment 1 and ended when the subject turned off the shower water. During this period, Mitch undressed, washed most body parts, and shampooed his hair. Task Segment 3 began with the end of Task Segment 2 and ended when the subject was dressed in his pajamas and slippers. This task had become very routine for Mitch, and no steps were omitted during any session of the experiment.

Task segment durations were measured by the experimenter using a stopwatch. During baseline, the experimenter assumed a position in the hallway that would permit observation of Mitch's bedroom and the bathroom. During intervention phases, timing took place in the room in which the subject was located. Interobserver agreement measures for the dependent and independent variables were collected in no less than 29% of the sessions across all conditions and phases of the study. All interobserver duration measures were within ±1 s (see Table 1).

Event recording was used to measure the integrity of the independent variables during all sessions. The following variables were measured during the conditions in which they occurred: (a) occurrence of vocal prompts, (b) occurrence of contingency statement, (c) occurrence of high-*p* commands, (d) compliance with high-*p* commands, and (e) delivery of contingent reinforcement. The integrity measures indicated that (a), (b), (c), and (e) were administered the number of times described in the procedure section on 100% of the sessions. Percentage compliance to high-*p* commands (d) was 96% for Mitch. Interobserver agreement computed on a trial-by-trial basis was 100% for all independent variables (see Table 1).

Procedures

Baseline. Sessions were begun at approximately 8:00 p.m. each evening. The experimenter approached Mitch, made eye contact, and provided the instruction to take a shower. No other instructions or contingencies were announced. The experimenter followed the subject upstairs and continued timing task duration from the hallway position. When Task Segment 3 was completed and the subject exited his bedroom, the experimenter said "Mitch, I'm glad to see you finished your shower."

Contingency management. Procedures in this condition were identical to baseline with the following exceptions. The experimenter (and secondary observer) stood approximately 1 to 3 m from the subject. Contingent on the first occurrence of off-task behavior the experimenter showed Mitch two cupcakes, two quarters, and one of his favorite books and said "Mitch, if you finish (last step in the task segment) by the time the buzzer sounds you can have your choice when you're done with your shower." "Off-task" was defined as 15 continuous seconds of any behavior that was unrelated to completion of the task. Examples included (a) repetitive motor movements such as removing or replacing his watch, wallet, comb, etc., (b) rearranging items on his dresser, (c) talking to himself or out of context without working on the task, and (d) staring into space. After stating the contingency, the experimenter set a kitchen timer for 16 min, positioned the timer within Mitch's view, and left the room. The 16-min criterion was 2 min lower than the subject's lowest baseline data point. When the timer sounded, the experimenter entered the room, told the subject whether or not the reinforcer had been earned, and praised successful task completion. On 85% of the sessions, the experimenter stated the contingency within 60 s of the onset of the task segment and between 60 s and 120 s during the remaining sessions.

Prompts. These procedures paralleled baseline except that the experimenter stood within 1 to 3 m of the subject and provided a combination vocal and gestural prompt to resume the task contingent on each occurrence of off-task behavior. The prompt was repeated every 15 s until the subject resumed on-task behavior. Descriptive praise was delivered for compliance with the prompts. An average of 4.7 prompts per session were required to sustain Mitch's involvement in the task (range, 1 to 13).

*High-*p *command sequence.* The procedures in this condition were the same as the prompt condition except that the high-*p* command sequence was applied instead of a prompt, contingent on each instance of off-task behavior. The high-*p* commands, timing of high-*p* commands, and descriptive praise were identical to Experiment 4. Durations of each high-*p* command sequence were included in the measures of task duration. The mean number of high-*p* command sequences administered per session was 1.8 and 1.5 during Phases 2 and 4, respectively.

Experimental Design

Experimental conditions were administered in the context of a four-phase multielement design. Baseline conditions were in effect during all task segments for the first and third phases of the experiment. Phase 2 randomly assigned the contingency management, vocal prompts, and the high-*p* command sequence conditions to Task Segments 1 through 3 for each day of the experiment. In the fourth phase, the high-*p* command sequence was applied during all three task segments per session.

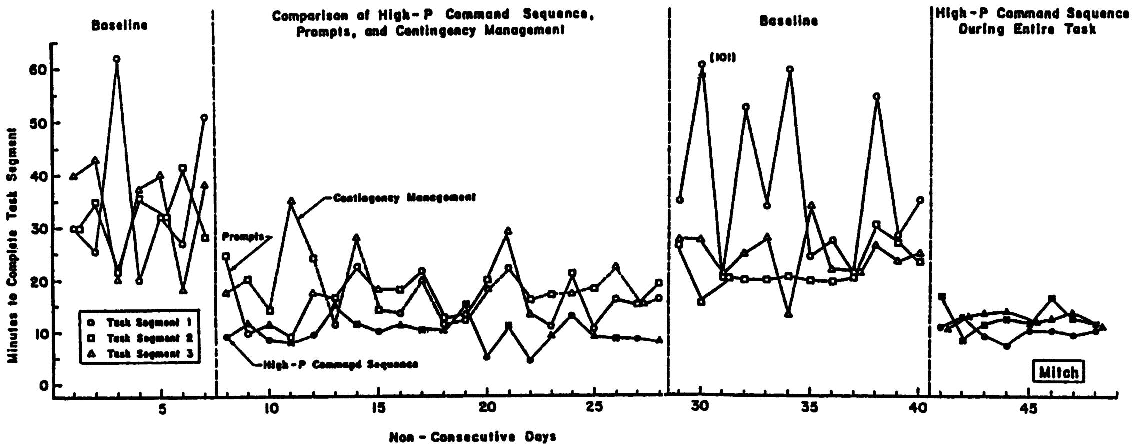

Figure 5. Minutes to complete each of three showering task segments during baseline, alternating treatments, and application of the most effective treatment during the entire task. Different data symbols correspond to different task segments.

RESULTS

Durations for each of the three task segments during all experimental conditions are presented in Figure 5. In the first baseline phase, durations were similar although quite variable across the three task segments. The average time spent performing Task Segment 1 was 35 min. Mean durations for the second and third task segments were 31.8 min and 33.9 min, respectively.

All three interventions resulted in faster performance of task segments compared to baseline. The most effective procedure was the high-*p* command sequence, which reduced task durations to a mean duration of 10.3 min per task segment (range, 4.3 min to 15.2 min). Prompts were the next most effective, reducing task duration to approximately one half of baseline. With prompts, task segment durations averaged 16.7 min. Least effective of the three interventions was the contingency management procedure. Reinforcement of short task durations resulted in an average of 18.4 min per task segment. Mitch met the criteria for reinforcement on 57% of the sessions during this condition.

The return to baseline condition in the third phase of the study again resulted in longer task durations. However, unlike the first baseline phase, Mitch spent considerably more time performing Task Segment 1 than Segments 2 and 3. Average duration for the first task segment was 40.7 min compared to 21.6 min and 28.7 min to complete Task Segments 2 and 3, respectively. Although performance in the second baseline was differentiated on the basis of task segment, the overall time required to complete the three task segments was similar for both baseline phases. Mean overall task duration was 100.7 min for Baseline 1 and 91 min for Baseline 2.

In the final phase of the study, the most effective intervention was applied during all task segments. Administration of the high-*p* command sequence during the entire task resulted in uniformly short task segment durations. The mean durations for Task Segments 1 through 3 were 9.7 min, 12.2 min, and 12.1 min, respectively. This resulted in an overall task duration mean of 33.9 min, which again was approximately one third of the baseline level.

GENERAL DISCUSSION

Concepts and findings from the basic behavior analysis literature stimulated the development of an innovative intervention for adult noncompliance. A nonhuman model of behavioral momentum (Nevin et al., 1983) was useful to predict how persons with severe developmental disabilities would respond to low-probability commands under different antecedent conditions. Presentation of a sequence of high-probability commands immediately prior to issuance of a task request increased the probability of compliance for some subjects and reduced compliance latency and task duration for other subjects. The precision of our analogy with Nevin's behavioral momentum, as well as the fit between behavioral and physical momentum, may at some point prove to be less than perfect. However, there may be applied and theoretical value in viewing behavioral momentum as a distinct phenomenon.

The applied value of the analogy lies in its inspiration of innovative intervention procedures. The high-probability command sequence used in the present research seemed to establish a series of responses with high behavioral mass. Commands that have a high probability of occasioning compliant responses are, we assume, discriminative stimuli for behavior that has produced reinforcement in the past. Although the exact reinforcers and their schedules were not analyzed in this research, the subjects quickly and reliably responded to the high-*p* requests and, anecdotally, seemed to enjoy doing so. Thus, it appears that by manipulating the type of command issued it is possible to reliably evoke behavior that effects reinforcement and, accordingly, establish a pattern of responding that has a relatively high behavioral mass. Interpreted from a behavioral momentum framework, increased compliance to low-*p* commands following the high-*p* sequence may illustrate resistance to change in the face of altered environmental conditions (i.e., when a low-*p* command is presented).

The results of Experiments 2, 3, and 4 offer some preliminary support for the appropriateness of the behavioral momentum analogy. First, Experiment 3 illustrated that when reinforcement rate was reduced by increasing the interval between the high-*p* sequence and low-*p* command, compliance to low-*p* commands decreased. This effect is predicted by the behavioral momentum analogy because decreases in reinforcement rate should produce corresponding decreases in resistance to change or behavioral momentum. Second, in the attention control conditions of Experiments 2 and 4, pleasant, neutral statements delivered to subjects on the same schedule as the high-*p* commands failed to alter compliance to low-*p* requests. This suggests the important role of the high-*p* command, which presumably serves as a discriminative stimulus for behavior maintained by high rates of reinforcement. We should emphasize, however, that these analyses are preliminary. Further research should directly manipulate reinforcement rates and intervals between high-*p* commands and compare reinforcement associated with neutral statements versus high-*p* commands.

Several dimensions of the present experiments differed from the basic work of Nevin et al. (1983). First, Nevin et al. directly manipulated subjects' access and rate of reinforcement. By contrast, we manipulated discriminative stimuli assumed to be correlated with reinforcement (i.e., high-*p* commands). Thus, without direct manipulation of reinforcement rates we must be cautious in our conclusion that the high-*p* procedure produced a relatively high behavioral mass. Second, if we can assume that reinforcement rates were manipulated indirectly with the high-*p* commands, the reinforcement schedule for compliance to high-*p* commands approximated a CRF schedule. This differed from Nevin et al.'s work in which resistance to change was examined under different, and highly intermittent, variable-interval (VI) schedules of reinforcement. Finally, Nevin et al. used a two-component, multiple-schedule procedure in which each component (i.e., reinforcement schedule) was correlated with a different discriminative stimulus (i.e., a red or green response key). Subjects' rate of responding was controlled by the discriminative stimuli only via their associated reinforcement schedule. In the present experiments, the rate of compliant responding was controlled directly by the number of high-*p* and low-*p* commands issued.

Given the differences between Nevin et al.'s (1983) basic research and the present attempt to apply these concepts in the high-*p* command procedure, alternative explanations for the results of the present research merit discussion. One plausible account may be stimulus generalization, which refers to the spread of the effects of reinforcement to stimulus conditions that have not been associated with reinforcement (Catania, 1984). Thus, stimulus generalization indicates a lack of stimulus control. When the subjects in the present experiments complied with low-*p* commands following the high-*p* command sequence, it could be said that compliance to high-*p* commands generalized to low-*p* commands and that the stimulus control of high-*p* commands was weak. However, as Nevin (1974) noted, stimulus generalization appears to be an instance of resistance to change rather than an alternative to it. During extinction, resistance to change is greatest at the training stimulus and decreases as the test stimulus departs from the training stimulus (Nevin, 1974, p. 406). Thus, the antecedent presentation of high-*p* commands may weaken the distinction between high- and low-probability commands, thereby increasing resistance to change and inducing stimulus generalization.

Our results also bear some resemblance to the effects reported in the generalized imitation literature. Several studies have shown that, following imitation training, subjects made imitative responses to unreinforced models (e.g., Baer & Sherman, 1964; Brigham & Sherman, 1968). Further, the probability of imitation to unreinforced models increased when unreinforced models were interspersed among models that were reinforced (Peterson, 1968) and decreased when discrimination between reinforced and unreinforced models was facilitated (Burgess, Burgess, & Esveldt, 1970). It may be possible to view the present findings in this context. The close temporal contiguity (5 s) between the high-*p* commands and the low-*p* command (i.e., interspersal) may have facilitated compliance to low-*p* commands whose historical association was presumably with relatively weak reinforcement. In Experiment 3, extending the IPT interval to 20 s may have induced discrimination between high-*p* and low-*p* commands, resulting in lower percentages of compliance to low-*p* commands. These speculations could be tested by randomly interjecting a low-*p* command in the high-*p* sequence and introducing stimuli antecedent to the low-*p* command that may enhance its discrimination (e.g., verbal statements or different experimenters correlated with different command types).

Future investigations of the high-*p* command sequence and/or applications of behavioral momentum could improve on some aspects of the methodology used in these experiments. First, all sessions were conducted by an experimenter who was aware of the experimental hypotheses. Where possible, staff who are uninformed of the experimental hypotheses should conduct sessions to avoid possible expectation effects and to assess the practical value of the procedures for applied settings. Second, as a novel intervention, the acceptability of the high-*p* command procedure should be assessed by those who use it and observe its use. The topography of high-*p* requests may need to be altered to be consistent with the subject's age and functioning level to gain widespread acceptance of the procedure. Finally, general conclusions regarding the comparative efficacy of the high-*p* procedure and the contingency management intervention (Experiment 5) should be made with caution. The degree of effectiveness of the contingency management procedure may have been influenced by the level at which the criterion was set. Perhaps a lower criterion would have resulted in shorter task durations and represented an optimally effective representation of contingency management (Van Houten, 1987).

Finally, we hope that the present findings will stimulate additional research on the use of high-*p* command sequences as well as investigations of behavioral momentum in applied settings. Conceivably, modifications could be made to the high-*p* command procedure that would make it applicable to a range of target behaviors and populations. In addition to studies with an applied focus, more research is needed to establish the appropriateness of the behavioral momentum analogy. Specifically, more experiments are needed that directly manipulate variables affecting behavioral mass and examine their relationship to the degree of persistent responding in applied settings. Enthusiasm for the applied value of the behavioral momentum analogy must await the outcome of these studies. However, at the very least, we must credit the heuristic value of Nevin et al.'s (1983) basic research in stimulating the development of an innovative treatment for noncompliance.

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